Abundance and Run Timing of Adult Pacific Salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2005: Weir Rebuild

Annual Report for Study 04-301

Ken Harper, Frank Harris and Steve J. Miller

U.S. Fish and Wildlife Service
Kenai Fish and Wildlife Field Office
Box 1670
Kenai, Alaska 99611

April 2007

Abundance and Run Timing of Adult Pacific Salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2005: Weir Rebuild

Ken Harper, Frank Harris, and Steve J. Miller

Abstract

The Kwethluk River weir was not operated in 2005. Cold spring temperatures followed by a rapid warming resulted in high water flows during the installation time period. Field crews comprised of personnel from the U.S. Fish and Wildlife Service and the Organized Village of Kwethluk prepared for weir installation in April 2005 but were placed on standby due to high water. Water levels remained elevated through mid-July prompting a decision to cancel weir operations. Managers used operational fund savings to repair and rebuild components of the Kwethluk River resistance board weir due to damage from flooding, ice, trees, logs and debris from the previous five years of operations. Between July 2005, and February 2006, hardware and materials were ordered, components fabricated and welded, and panels assembled by village employees under the Service's supervision in Bethel. In March 2006, new weir panels were crated, staged for airlift and moved to the weir site in April. Weir panel width was reduced from 121 cm to 102 cm, which decreased panel weight, eased handling, and accommodated installation. Overall panel length remained at 6 m.

Introduction

The Kwethluk River, a lower Kuskokwim River tributary located on the Yukon Delta National Wildlife Refuge (Refuge), provides important spawning and rearing habitat for chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, sockeye *O. nerka*, pink *O. gorbuscha*, and coho *O. kisutch* salmon (Figure 1) (Alt 1977; U.S. Fish and Wildlife Service 1992). Adult salmon returning to the Kwethluk River migrate 130 river kilometers (rkms) through the lower Kuskokwim River and up to an additional 160 rkms in the Kwethluk River before reaching spawning grounds. In the lower Kuskokwim River, salmon pass through one of Alaska's most intensive subsistence fisheries (Burkey et al. 2001; U.S. Fish and Wildlife Service 1988). In general, half the total statewide subsistence harvest of Chinook salmon occurs in the Kuskokwim drainage (ADFG 2001, 2002, 2003a, 2003b).

The Alaska National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats 'be conserved in their natural diversity' within federal lands; that international treaty obligations are fulfilled, and subsistence opportunities for local residents be maintained. Salmon escapement studies for the Kuskokwim River tributaries on the Refuge are priorities in the Refuge Fishery Management Plan (U.S. Fish and Wildlife Service 1992). However, management of these mixed species systems of multiple individual stocks is not straight forward. Escapement, run timing, and other data are required for sound management strategies (Roettiger et al. 2002, 2004, Zabkar and Harper 2003).

In accordance with ANILCA mandates, various enumeration studies have occurred on the Kwethluk River with varying results. The Service and other organizations have funded projects from 1991 to present. Project objectives remain the same: (1) enumerate adult salmon; (2) describe the run timing for chum, Chinook, sockeye, pink, and coho salmon returns; (3) estimate the age, sex, and length composition of adult chum, Chinook, sockeye, and coho salmon populations; and (4) identify and count other fish species passing through the weir.

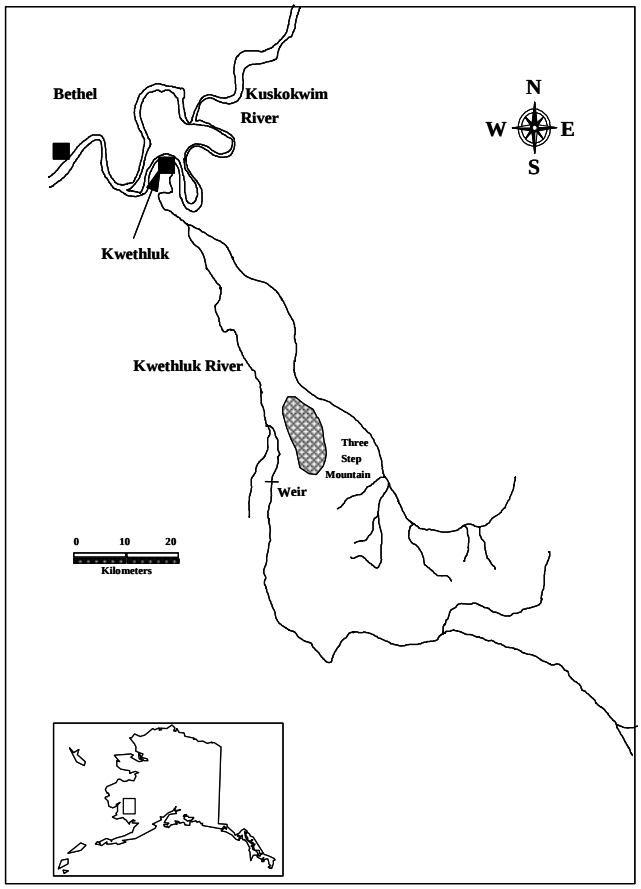

FIGURE 1.–Location of the Kwethluk River weir.

In 1991, the Kenai Fish and Wildlife Field Office (KFWFO) did not install the Kwethluk River weir due to high water, but in 1992 successfully installed and operated the weir (Harper 1998). However, in September 1992, the Organized Village of Kwethluk (OVK) passed resolutions opposing the weir. In 1996, the Association of Village Council Presidents (AVCP) initiated a counting tower project on the Kwethluk River to enumerate salmon escapements, which operated through 1999. Counts of chum, Chinook, and sockeye salmon were obtained from a tower operated on the Kwethluk River between 1996 and 1999 (Cappiello and Sundown 1998, Cappiello and Chris 1999). Past high water events prevented weir operations entirely in 1991, and 2005 and delayed installation until August 12, 2001. High spring flows in 1998 prevented tower operators from enumerating salmon passage prior to July 24 and after August. The Kwethluk River weir has had full seasons of operation in 1992, 2000, 2002, 2003, and 2004.

Because of the importance of the Kwethluk River to the subsistence fisheries, the Kwethluk River weir was one of the first enumeration projects funded under the U.S. Fish and Wildlife Service, Office of Subsistence Management (OSM) in 2000. The KFWFO and the OVK have cooperatively operated this weir from 2000-2004 and the rebuild in 2005-06.

Beginning in 2000 the Kwethluk River weir has played an important role as a platform to collect additional information by other researchers for other projects. These include collections of Chinook and coho samples for genetic studies (OSM projects;01-070, 02-097, 03-041, and 04-311, Crane et al. 2004, Templin et al. 2004, Olsen et al. 2006a,b), and monitoring for tags from Kuskokwim River mark-recapture projects for sockeye, chum and coho salmon (Kerkvliet et al. 2004). It also plays an important role in the development of a total in-river abundance estimate for Chinook salmon (OSM projects 02-046, 05-302, 05-305, Stuby 2003, 2004, 2005, 2006) by providing escapement numbers from a lower Kuskokwim River tributary. Beginning in 2004, the Salmonid Rivers Observatory Network (SaRON), started a 10 year project focusing on pristine salmon producing rivers in the Bering Sea drainage. Escapement data from the Kwethluk River are components needed for measuring processes and changes to the shifting habitat mosaic of ecosystems (http://www.umt.edu/flbs/Research/SaRON.htm). Alaska Yukon Kuskokwim Sustainable Salmon Initiative (AYK-SSI) initiated a juvenile emigration study (http://www.aykssi.org/Research/index.htm) on the Kwethluk River starting 2006. This research will incorporate adult escapement and juvenile out migration data collected from the Kwethluk River weir.

Methods

Weir Operations

Weir installation has to occur during a short time period between ice out and spring high flows fed by snow pack from the higher elevations of the Kilbuk Mountains. Workable flow and water level conditions depend upon ambient temperature, snow pack, and rainfall, and occur while the Kuskokwim River near Bethel and the lower 40 km of the Kwethluk River remain frozen. Aerial surveys are flown by refuge pilots from late March through late April to monitor for favorable water conditions that allow installation.

When conditions are favorable, the crew is transported by helicopter to the site to establish camp, remove snow and shore ice with pick and shovel, inspect and repair substrate rail, install bulkheads, and attach weir panels. Resistance boards are not set at this time so panels remain submerged and allow passage of ice, trees, logs and debris during high water. Weir installation in mid to late-April normally occurs prior to high water discharges. The third week of June, the weir is inspected and made fish tight with the addition of fixed pickets where the weir transitions to the shore, holes under the weir are plugged, and the resistance boards are set.

Construction

Weir panels were assembled in Bethel in February using components fabricated in Kenai from July through November, and PVC electrical conduit shipped to Bethel. New panels were reduced in width from the original design (Tobin 1994) and are similar to those described for the Tuluksak River by Gates and Harper (2002) and Stewart (2002) eliminating connector yokes. The reduced size, 1.02 vs. 1.2 m width reduced weight and promoted ease of handling. New stringers were drilled with 13 holes with the two holes at each end used to attach adjacent panels (Figure 2). In order to recycle old materials and use newer construction techniques, two different designs were used to construct the 0.86 m wide resistance boards. Thirty-six were constructed using plywood with aluminum channel around the edges described by Tobin (1994), while the 24 were constructed of aluminum sheeting and blue board (Figure 3) described by Gates and Harper (2002).

Discussion

Water levels and conditions conducive to weir installation on the Kwethluk River generally occur mid-April. Installation at this early date however subjects weir components to damage from ice and debris. The majority of damage to the weir occurs between installation and the beginning of operations. Due to the age of the weir and its continual exposure to high water events, repairs have consumed more time annually. For example, 12 panels or 25% of the weir needed repair or replacement during installation in 2004. At the end of 2004, approximately 90% of the existing panels needed some form of repair of which 50% required multiple repairs including replacement of either lost or damaged resistance boards. Rail sections that become damaged during the winter are replaced annually when needed.

In 2005 aerial surveys were flown, crews hired, and supplies ordered in preparation for weir installation. Water conditions went from open water on March 17, to completely frozen on April 12, back to open water with shore fast ice on April 23, and transitioned to flood stage on April 27 (Photos 1-4). No window of opportunity occurred for weir installation in 2005. Crews hired by OVK were placed on standby as more aerial flights were flown to evaluate water levels and installation conditions. Ambient temperatures were below previous years on April 17 and then started rising rapidly through April 30 (Figure 4). Water levels remained high through July as snow pack in the higher elevations continued to melt (Photo 5). The decision to cancel weir operations was made on July 10. This date corresponds with the median passage date of chum and Chinook salmon in 2004 (Figure 5). The remaining 2005 operational funds were then directed towards purchasing materials and rebuilding weir panels and components.

After the decision to cancel 2005 operations, materials and components to rebuild the weir were purchased, and shipped to Kenai and Bethel. Picket materials (6 m PVC pipe) were shipped via barge to reduce costs. Components for the weir were fabricated in Kenai which included over 600 stringers, resistance boards, base plates, and boat passage hardware during the summer and fall of 2005. Operational funds were expended during 2005 for KFWFO personnel to complete the 2004 report, prepare for spring installation, and repair equipment needed to install the weir. Carry over funds in the OVK contract made it possible to hire local residents from Kwethluk to assist KFWFO personnel in weir panel construction. These individuals constructed 70 new weir panels between January 24 and February 12, 2006. The Refuge provided heated warehouse space to fabricate changes and construct new panels. The crew made jigs to consistently cut components to precise measurements and glue the components together accurately, see Photos 6 and 7 (Tobin 1994, Stewart 2002).

The crew constructed four large wooden crates approximately 1.2 by 1.2 m wide, by 6 m in length that held up to 20 weir panels. The total crate weight with weir panels was under the 1,100 kg maximum specified for airlift by helicopter. The crates were screwed and bolted together and then bound by metal strapping and nylon web ratchet straps. On April 25, 2006 the crated panels were flown in to the weir site (Photo 8)

Recommendations

Sufficient annual operational funds are needed to perform adequate yearly maintenance. Materials and supplies should be budgeted for and purchased to construct or repair 20 panels during the summer months by the crew. These panels would be available as needed and pressed

into service during installation each year. Additional engineering should be undertaken to design weir panel components that can be installed in high water events. The river channel at the current weir site is shifting, gravel deposits are forming and the weir will need to be moved perhaps as soon as 2008 operations. A future weir site has been identified but needs further evaluation.

The Kwethluk River weir continues to be an important tool for monitoring salmon stocks originating on the Refuge and providing information to the federal and state managers of the lower Kuskokwim River fisheries. It has also become an important platform for data associated or linked with other research studies taking place in the Kwethluk River, the Kuskokwim drainage and the Bering Sea ecosystem . It is recommended the weir project continue to be operated on a yearly basis, early installation prior to spring runoff take place, and operated in to September to monitor coho salmon escapements. To fulfill obligations and recommendations the existing weir may need extensive repairs or replacement from time to time and funding to do such made a priority.

Acknowledgements

Special appreciation is extended to the crew that rebuilt the weir: William Egwoak, John Fisher, and Brian Spein from the OVK. Throughout the season the Refuge staff provided air support, and use of their heated warehouse for construction.

The U.S. Fish and Wildlife Service, Office of Subsistence Management provided funding for this project through the Fisheries Resource Monitoring Program, Project FIS 04-301. In 2004 a new contract (No. 701814C147) was established between the Service and OVK that replaced the prior cooperative agreement. Martin Andrew, President, Kwethluk IRA Council, and Herman Evan, Project Manager, provided administrative support for OVK. As a partner, the OVK provided technicians to staff the weir, purchased supplies, and performed equipment maintenance.

References

Alt, K. 1977. Inventory and cataloging in Western Alaska waters. Alaska Department of Fish and Game, Federal Aid in Fish Restoration Completion Report, Study G-I-P, Vol. 18, Juneau, Alaska.

Alaska Department of Fish and Game. 2001. Alaska subsistence fisheries 1999 annual report. Alaska Department of Fish and Game, Division of Subsistence, Juneau.

Alaska Department of Fish and Game. 2002. Alaska subsistence fisheries 2000 annual report. Alaska Department of Fish and Game, Division of Subsistence, Juneau.

Alaska Department of Fish and Game. 2003a. Alaska subsistence fisheries 2001 annual report. Alaska Department of Fish and Game, Division of Subsistence, Juneau.

Alaska Department of Fish and Game. 2003b. Alaska subsistence fisheries 2002 annual report. Alaska Department of Fish and Game, Division of Subsistence, Juneau.

Burkey, C., M. Coffing, J. Menard, D. Molyneaux, P. Salomone, C. Utermohle.2001. Annual management report for the subsistence and commercial fisheries of the Kuskokwim area, 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries, AYK Region, Regional Information Report No. 3A01-34, Anchorage, Alaska.

Cappiello, T., and J. Chris. 1999. Kwethluk River counting tower salmon assessment project, 1998. Regional Information Report No. 3A99-20. Alaska Department of Fish and Game, Commercial Fisheries Division, Anchorage.

Cappiello, T., and R. Sundown. 1998. Kwethluk River counting tower salmon assessment project, 1996-1997. Regional Information Report No. 3A97-44. Alaska Department of Fish and Game, Commercial Fisheries Division, Anchorage.

Crane, P., D. Molyneaux, S. Miller, K. Harper, and J. Wenburg. 2004. Genetic variation among coho salmon populations from the Kuskokwim River region and application to stock-specific harvest estimation. U. S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report (Study No. 03-041). U. S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Anchorage, Alaska.

Gates, K.S., and K.C. Harper. 2002. Run Timing and Abundance of Adult Pacific Salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2001. U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office. Alaska Fisheries Data Series Number 2002-6, Kenai, Alaska

Harper, K. C. 1998. Run timing and abundance of adult salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 1992. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Technical Report Number 44, Kenai, Alaska.

Kerkvliet, C. M., J. Pawluk, T. Hamazaki, K. E. Hyer, and D. Cannon. 2004. A mark-recapture experiment to estimate the abundance of Kuskokwim River sockeye, chum, and coho salmon, 2003. U. S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Annual Report (Study No. 03-030). Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A04-14, Anchorage, Alaska.

Olsen, J. B., S.J. Miller, K.C. Harper, and J.K. Wenberg. 2006a. The influence of male-biased escapement on the effective number of breeders in western Alaska Chinook salmon.

Olsen, J. B., S.J. Miller, K.C. Harper, and J.J. Nagler. 2006b. Contrasting sex ratios in juvenile and adult Chinook salmon Oncorhynchus tshawytscha (Walbaum) from south-west Alaska: sex reversal or differential survival. Journal of Fish Biology (2006) 69 (Supplement A), 140–144.

Roettiger, T., K. Harper and A. Chikowsky. 2002. Abundance and run timing of adult salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2001. Alaska Fisheries Data Series 2002-8.

Roettiger, T., F. Harris, and K. Harper. 2004. Abundance and run timing of adult salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2003. Alaska Fisheries Data Series 2004-8.

Stuby, L. 2003. Inriver abundance of chinook salmon in the Kuskokwim River, 2002. Annual Report for Study 02-015, USFWS Office of Subsistence Management, Fishery Information Service Division. Alaska Department of Fish and Game, Fishery Data Series No. 03-22, Anchorage.

Stuby, L. 2004. Inriver abundance of Chinook salmon in the Kuskokwim River, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 04-30, Anchorage.

Stuby, L. 2005. Inriver abundance of Chinook salmon in the Kuskokwim River, 2002-2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-39, Anchorage

Stuby, L. 2006. Inriver abundance of Chinook salmon in the Kuskokwim River, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 06-45, Anchorage

Stewart, R. 2002. Resistance board weir panel construction manual. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A02-21, Anchorage, Alaska.

Templin, W.D., C.T. Smith, D. Molyneaux, and L.W. Seeb. 2004. Genetic Diversity of Chinook Salmon from the Kuskokwim River. USFWS Office of Subsistence Management, Fisheries Resource monitoring Program, Final Report No. 01-070, Anchorage, Alaska.

Tobin, J.H. 1994. Construction and performance of a portable resistance board weir for counting migrating adult salmon in rivers. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Technical Report Number 22, Kenai, Alaska.

U.S. Fish and Wildlife Service. 1988. Yukon Delta National Wildlife Refuge comprehensive conservation plan, environmental impact statement, wilderness review, and wild river plan. U.S. Department of Interior, Fish and Wildlife Service, Anchorage, Alaska.

U.S. Fish and Wildlife Service. 1992. Fishery Management Plan for the Yukon Delta National Wildlife Refuge. U.S. Fish and Wildlife Service, Anchorage, Alaska.

Zabkar, L.M., K.C. Harper. 2003. Abundance and Run Timing of Adult Pacific Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 2001 and 2002. Alaska Fisheries Data Series Number 2003-5.

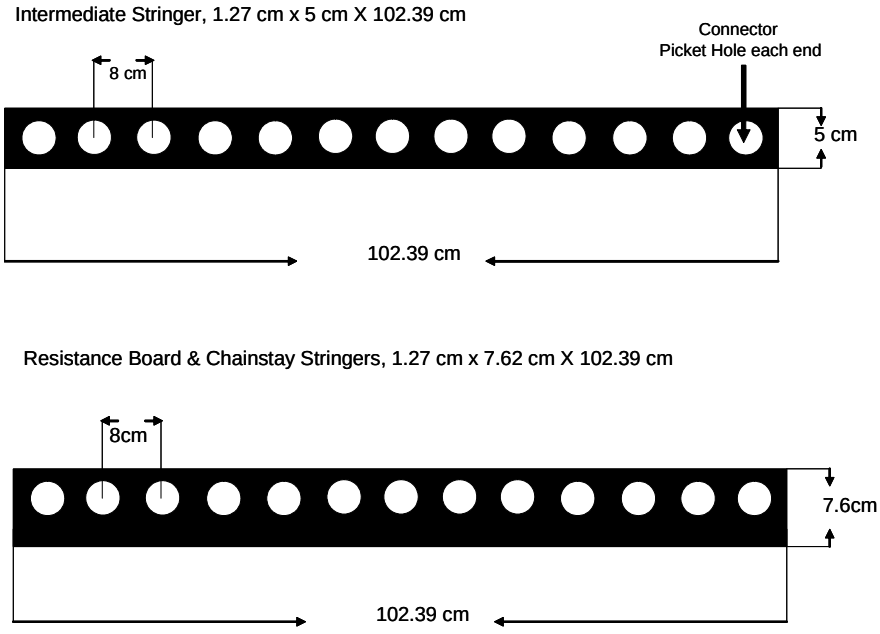

FIGURE 2.–Stringer design specifications used for construction of modified weir panels.

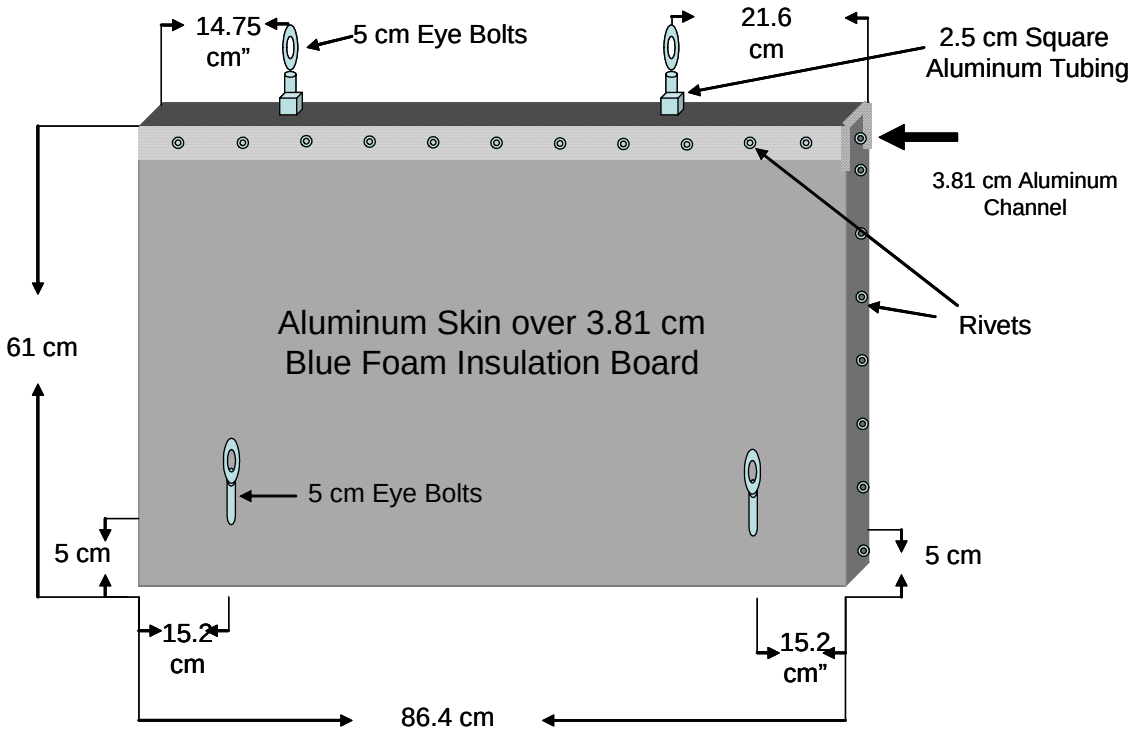

FIGURE 3.–Design specifications for modified resistance boards.

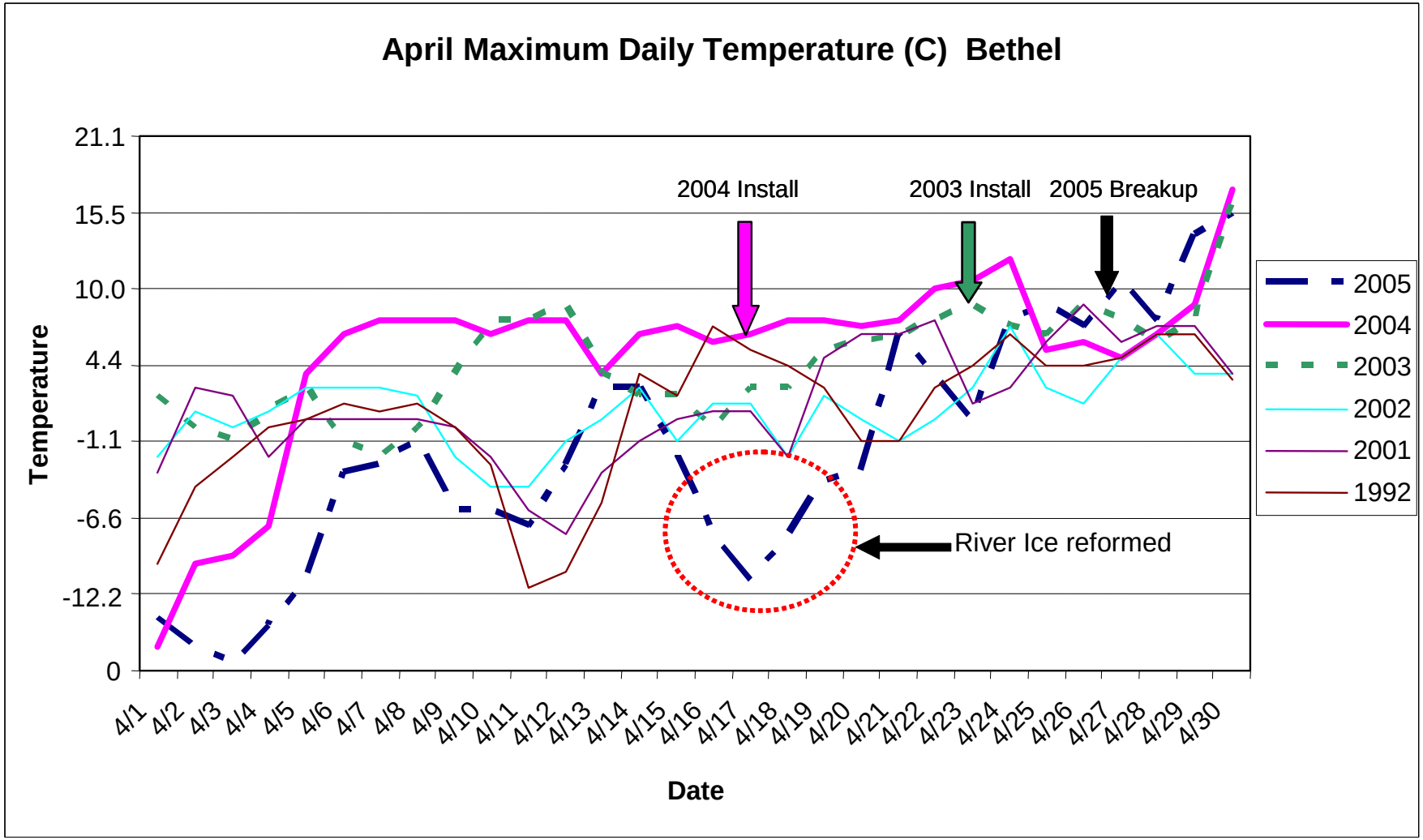

FIGURE 4. –Bethel daily temperatures for the month of April in years 1992, 2001, 2002, 2003, 2004, and 2005. Note low temperatures April 1-5, April 12, and April 18, followed by higher temperatures exceeding 15.5ºC on April 30, 2005.

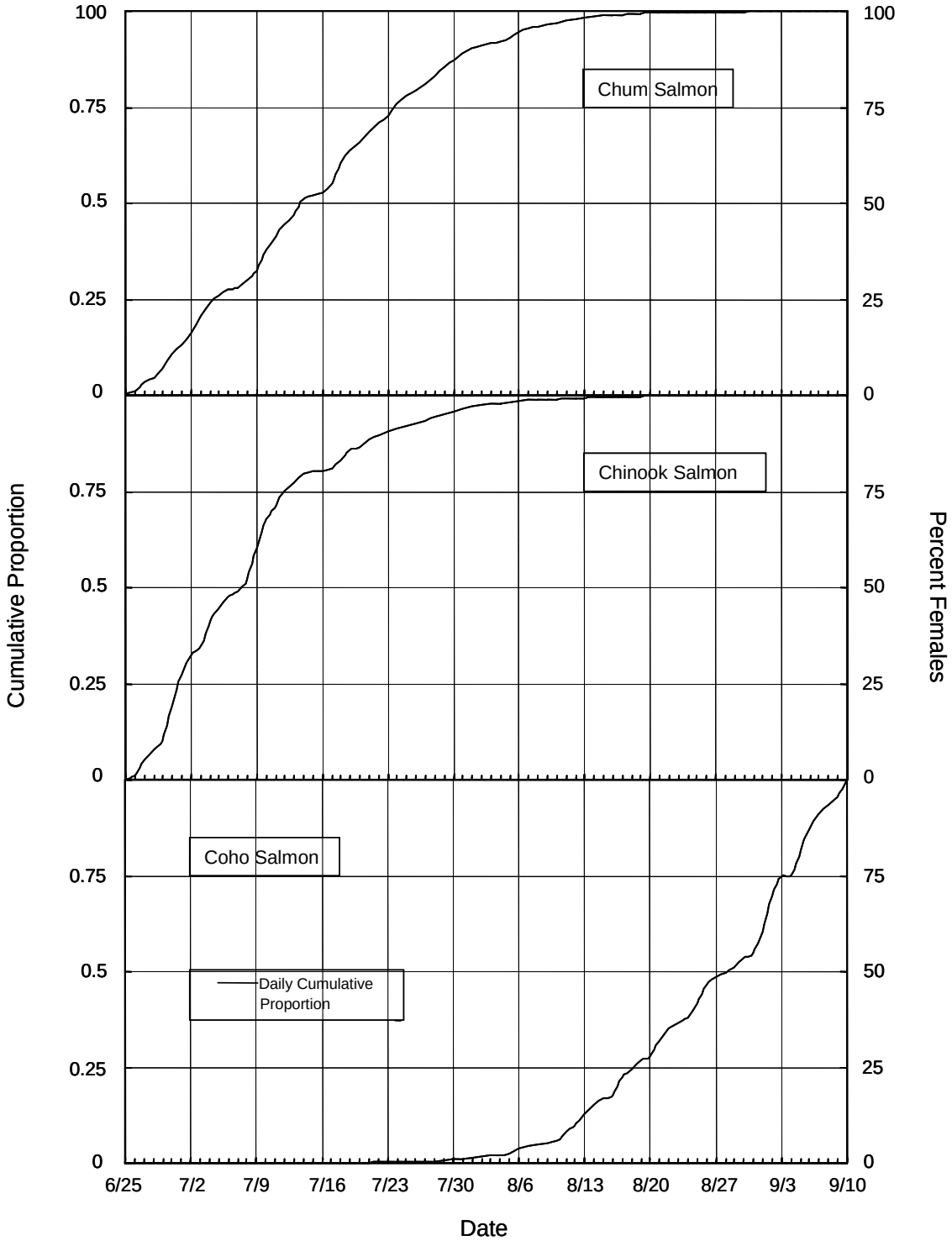

FIGURE 5. –Daily cumulative proportions of chum, Chinook and coho salmon at the Kwethluk River weir, 2004.

Photos

PHOTO 1.–Aerial photo taken March 17, 2005. Weir site with heavy shore ice present. Line represents approximate location of substrate rail.

PHOTO 2.–Aerial photo taken April 12, 2005. Line represents approximate location of base rail. Cooler temperatures refroze the river channel.

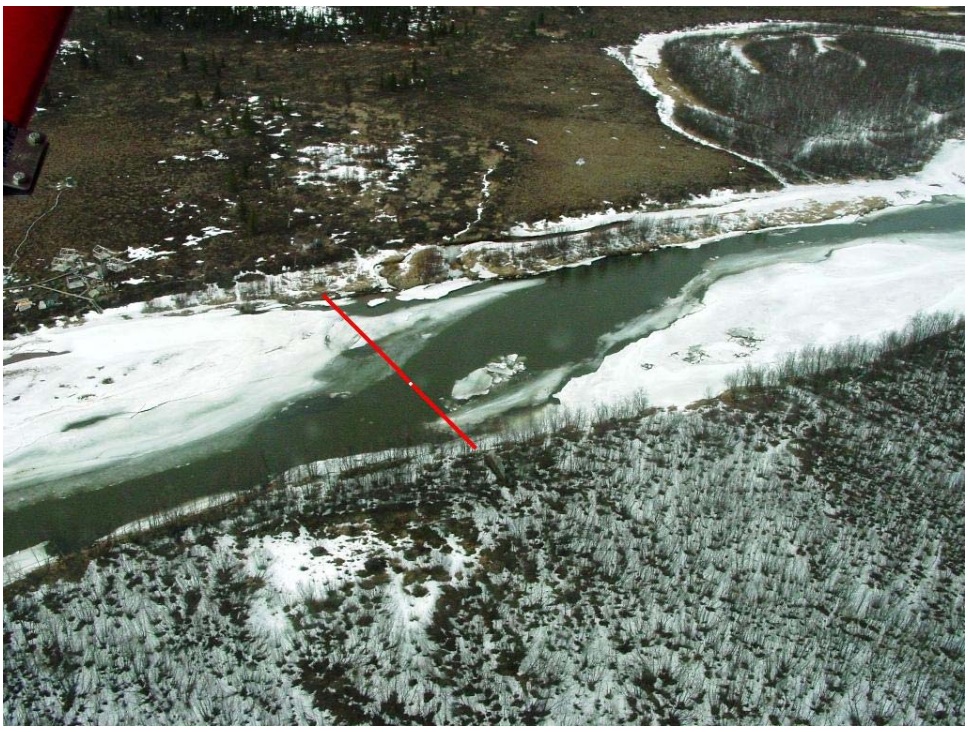

PHOTO 3.–Aerial photo taken April 25, 2005. Thick shore-fast ice and submerged ice along both banks. Line represents approximate location of substrate rail.

PHOTO 4.–Aerial photo taken April 27, 2005. Warming temperatures turned low waters into high waters. Line represents approximate location of substrate rail. Note loss of snow in 2 days.

PHOTO 5.–Photo taken June 3, 2005. Water levels remained high.

PHOTO 6.–Photo taken January 30, 2006. Work area inside the Refuge warehouse and panel jig on saw horses.

PHOTO 7.–Photo taken February 7, 2006. Brian Spein of OVK fabricating weir components. Helmets which supplied fresh air were used during gluing operations.

PHOTO 8.–Photo taken April 15, 2006. Helicopter air-lifting crated panels into the weir site.